

TUNER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to tuners, and more particularly, to a tuner that prevents a reference frequency signal from being superposed as a disturbance signal on a local oscillating signal.

2. Description of the Related Art

In CATV, programs for several tens of channels can be transmitted by re-transmitting a broadcasting wave, a vacant channel, a middle band, and a super band. In such CATV, since both signal scrambling and transmission of necessary information are performed to select a program and perform accounting, a double-conversion tuner is placed before a receiver to perform receiving.

Fig. 3 is a block diagram of a tuner related to the present invention. A tuner 50 is provided with an input terminal 1, first to fourth band-pass filters 2a to 2d, an automatic gain controller 3, first to third amplifiers 4a to 4c, first and second mixers 5a and 5b, first and second voltage controlled oscillators 6a and 6b, first and second

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PLL ICs 7a and 7b, a reference oscillator circuit 8, and an output terminal 9.

The tuner 50 is a double-conversion type, in which the frequency of an input signal is increased by an upconverter and then, decreased by a downconverter to remove disturbance.

The operation of the tuner 50 will be described next. An input signal input to the input terminal 1 is attenuated at frequencies other than those in the frequency band of a desired receiving signal by a first bandpass filter 2a, limited to a predetermined level range by an automatic gain controller 3 according to an automatic-gain-control voltage based on the receiving-signal level, amplified by a first amplifier 4a, and sent to a first mixer 5a. The first mixer 5a converts the input signal to a first intermediate-frequency signal according to a first local oscillating signal output from the first voltage controlled oscillator 6a. In this case, the oscillating frequency of the first voltage controlled oscillator 6a is controlled and stabilized by a first PLL circuit included in the first PLL IC 7a.

The first intermediate-frequency signal output from the first mixer 5a is attenuated at frequencies other than those in a first intermediate-frequency band by the second bandpass filter 2b, amplified by the second amplifier 4b, attenuated again at frequencies other than those in the

first intermediate-frequency band, and sent to the second mixer 5b. The second mixer 5b converts the input first intermediate-frequency signal to a second intermediate-frequency signal according to a second local oscillating signal output from the second voltage controlled oscillator 6b. In this case, the oscillating frequency of the second voltage controlled oscillator 6b is controlled and stabilized by a second PLL circuit included in the second PLL IC 7b. The second intermediate-frequency signal output from the second mixer 5b is attenuated at frequencies other than those in a second intermediate-frequency band by the fourth bandpass filter 2d, amplified by the third amplifier 4c, and output from the output terminal 9.

The first PLL IC 7a and the reference oscillator circuit 8 are directly connected, and the second PLL IC 7b and the reference oscillator circuit 8 are connected through a capacitor C2 and an amplifier AMP. The reference oscillator circuit 8 includes a crystal oscillator X and a capacitor C1, and sends a reference-frequency signal oscillated by a reference oscillating circuit including the reference oscillator circuit 8 and an amplifier included in the first PLL IC 7a, to the first voltage controlled oscillator 6a. The reference-frequency signal is also sent to the second PLL IC 7b through the capacitor C2 and the amplifier AMP.

In the tuner described above, the first voltage controlled oscillator, the reference oscillator circuit, and the first PLL IC, which includes the amplifier for reference oscillation, are located close to each other in a cabinet due to recent demands for compactness. In such a case, the first local oscillating signal flows undesirably into the amplifier from a connection terminal between the reference oscillator circuit and the first PLL IC. The reference-frequency signal is mixed with the first local oscillating signal or the first local oscillating signal is superposed on the reference-frequency signal. The mixed or superposed signal is added to the first voltage controlled oscillator through the first PLL IC. Since the oscillating frequency of a crystal oscillator in the reference oscillator circuit usually falls in the 4-MHz band, the mixed or superposed signal has two frequencies that are equal to that of the first local oscillating signal frequency ± 4 MHz. Because the frequencies of the signal fall in an analog-video-system transmission bandwidth, 6 MHz, the signal functions as a disturbance wave and reduces the image quality of CATV.

SUMMARY OF THE INVENTION

In order to overcome the problems described above, preferred embodiments of the present invention provide a tuner that effectively prevents a reference oscillating

oscillator and for controlling the oscillating frequency of the oscillating signal of the voltage controlled oscillator according to a result of the comparison made by the PLL circuit, and a mixer for converting an input signal to an intermediate-frequency signal in frequency according to the oscillating signal of the voltage controlled oscillator, wherein a filter is connected between the reference oscillator circuit and the amplifier to pass the oscillating signal of the reference oscillating circuit and to block the oscillating signal of the voltage controlled oscillator.

In accordance with another preferred embodiment of the present invention, a tuner includes a reference oscillating circuit, a voltage controlled oscillator, a PLL circuit for comparing in phase the oscillating signal of the reference oscillating circuit and the oscillating signal of the voltage controlled oscillator and for controlling the oscillating frequency of the oscillating signal of the voltage controlled oscillator according to a result of comparison made by the PLL circuit, and a mixer for converting an input signal to an intermediate-frequency signal in frequency according to the oscillating signal of the voltage controlled oscillator, wherein an inductance device is connected between the reference oscillating circuit and the PLL circuit to pass the oscillating signal of the reference oscillating circuit and to block the

In yet another preferred embodiment of the present invention, a tuner includes a reference oscillating circuit, a voltage controlled oscillator, a PLL circuit for comparing in phase the oscillating signal of the reference oscillating circuit and the oscillating signal of the voltage controlled oscillator and for controlling the oscillating frequency of the oscillating signal of the voltage controlled oscillator according to a result of the comparison made by the PLL circuit, and a mixer for converting an input signal to an intermediate-frequency signal in frequency according to the oscillating signal of the voltage controlled oscillator, wherein a filter is connected between the reference oscillating circuit and the PLL circuit to pass the oscillating signal of the reference oscillating circuit and to block the oscillating signal of the voltage controlled oscillator.

According to a tuner of various preferred embodiments of the present invention, since an inductance device or a filter for passing a reference-frequency signal and for blocking the oscillating signal of a voltage controlled oscillator is connected between a reference oscillator circuit and an amplifier circuit, or between a reference oscillating circuit and a PLL circuit, the reference-frequency signal is reliably and effectively prevented from

being superposed as a disturbance signal on the oscillating signal of the voltage controlled oscillator.

According to a tuner of various preferred embodiments of the present invention, since an inductance device or a filter for passing a reference-frequency signal and for blocking the oscillating signal of a voltage controlled oscillator is connected between a reference oscillator circuit and an amplifier circuit included in a PLL IC, the oscillating signal of the voltage controlled oscillator is prevented from being superposed as a disturbance signal on the reference-frequency signal transmitted from a reference oscillating circuit formed of the reference oscillator circuit and the amplifier included in the PLL circuit, to the voltage controlled oscillator. As a result, the reference-frequency signal is prevented from being superposed as a disturbance signal on the first local oscillating signal.

Therefore, even when a voltage controlled oscillator, a reference oscillator circuit, and a PLL IC are located close to each other due to recent requirements for compactness, the image quality of CATV is not deteriorated.

Other features, elements, characteristics and advantages of the present invention will become more apparent from the detailed description of preferred embodiments below with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a tuner according to a first preferred embodiment of the present invention.

Fig. 2 is a block diagram of a tuner according to a second preferred embodiment of the present invention.

Fig. 3 is a block diagram of a related tuner.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be described with reference to the attached drawings. The same reference numerals as those used to describe the related tuner above will be used to represent the same elements in the present invention described below.

Fig. 1 is a block diagram of a tuner according to a first preferred embodiment of the present invention. A tuner 10 preferably includes an input terminal 1, first to fourth band-pass filters 2a to 2d, an automatic gain controller 3, first to third amplifiers 4a to 4c, first and second mixers 5a and 5b, first and second voltage controlled oscillators 6a and 6b, first and second PLL ICs 7a and 7b, a reference oscillator circuit 8, and an output terminal 9, in the same way as the tuner 50 in the related device described above.

The second PLL IC 7b and the reference oscillator

circuit 8 are connected through a capacitor C2 and an amplifier AMP in the same way as the tuner 50 in the related device described above. An amplifier built in the first PLL IC 7a is connected to the reference oscillator circuit 8 through an inductor L1, which defines an inductance device.

The reference oscillator circuit 8 and the amplifier built in the first PLL IC 7a define a reference oscillating circuit.

The inductor L1 is preferably defined by a printing pattern, and its inductance is as small as about 15 nH so as to block the oscillating signal of the first voltage controlled oscillator 6a. More specifically, the impedance of the inductor L1 is preferably about 0.38Ω at the oscillating frequency (4 MHz) of the reference oscillating circuit and is preferably about 141.3Ω at the oscillating frequency (1.5 GHz) of the first voltage controlled oscillator 6a.

Fig. 2 is a block diagram of a tuner according to a second preferred embodiment of the present invention. A tuner 20 differs from the tuner 10 (shown in Fig. 1) of the first preferred embodiment in that the first PLL IC 7a and the reference oscillating circuit 8 are connected through a low-pass filter F defined by an inductor L2 and capacitors C3 and C4.

Similar to the tuner 10 (shown in Fig. 1) of the first

preferred embodiment, the reference oscillator circuit 8 and an amplifier built in the first PLL IC 7a define a reference oscillating circuit.

The inductance of the inductor L2 and the capacitances of the capacitors C3 and C4 are constructed so as to pass the oscillating signal (4 MHz) of the reference oscillating circuit and to block the oscillating signal (1.5 GHz) of the first voltage controlled oscillator 6a.

According to the tuners of the above-described preferred embodiments, the inductance device or the filter is connected between the reference oscillator circuit and the amplifier built in the first PLL IC so as to pass the oscillating signal of the reference oscillating circuit and so as to block the oscillating signal of the first voltage controlled oscillator 6a, which is a first local oscillating signal. Therefore, the first local oscillating signal is prevented from being superposed as a disturbance wave on the reference-frequency signal. As a result, the reference frequency signal is prevented from being superposed as a disturbance wave on the first local oscillating signal.

Therefore, even when a voltage controlled oscillator and a reference oscillator circuit are located close to each other due to recently demanded compactness, the image quality of CATV is not deteriorated.

In the above-described preferred embodiments, the

In the above-described preferred embodiments, the inductances are preferably defined by printing patterns but may be defined by other suitable elements. Even when the inductances are defined by chip coils or air-core coils, for example, the same advantages are obtained.

In each of the above-described preferred embodiments, the first PLL IC preferably includes the amplifier used for the reference oscillating circuit. Even when the amplifier used for the reference oscillating circuit is externally connected to the first PLL IC, the same operations and the same advantages are obtained.

When the amplifier used for the reference oscillating circuit is not included in the first PLL IC, the output of the reference oscillating circuit defined by the reference

oscillator circuit and the amplifier is input to the first PLL IC. When an inductance device or a filter is connected between the reference oscillating circuit and the first PLL IC, the same operations and the same advantages are obtained.

While preferred embodiments of the invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing the scope and spirit of the invention. The scope of the invention, therefore, is to be determined solely by the following claims.

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